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EXTRA

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For **questions or comments** please contact Mieke Groot <mieke@iwacc.com>.

(Max van Kelegom has abandoned Verkeer-Zien on March 2nd 2018.)

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(Max van Kelegom heeft Verkeer-Zien op 2 maart 2018 in de steek gelaten.)

Babel or babble?

by Ruurd Groot (with help from Mieke Groot, Max van Kelegom and Jur Groot)

part two
A confusion of tongues & images in traffic science

Introduction

The first part of this text focused on limits of natural language and its built-in intuitive concepts We talk about people's motives and behaviour like we talk about cars, and vice versa. A car or a person might occasionally be called moody or quirky, and this perfectly conveys what we mean to another person. By these words we may share an experience. However, that kind of talk goes awry when we start applying it to the problem of how such a condition might come about. When it comes to the crunch, the natural way of thinking and talking is unfit for analyzing and explaining the causing process. This second part focuses on deeper problems of misunderstanding and misinterpretation, to end with a few current examples from traffic science.

Again, a few notes *(note 1 to note 3)* are added to expand on certain details and a number of references *(reference a to reference i)* is included after the notes. Finally, at the end, sources for the four illustrations are given.

Discussion

In old-fashioned psychology, which had to start from scratch, natural language and its concepts were the only available tools. An obvious source was traditional literature, which ever since the days of Homer describes human behaviours in terms of their supposed inner causes. Of course, psychology being a scholarly activity, the vulgar crudities were soon replaced by more exalted terms; but for a long while the logic and structure of the new paradigms kept showing traces of the original approach, which was reflected in the methods. When discussing mind and behaviour the old ways still shone through – and they sometimes still do. Psychological analysis may turn into something like a narrative, and narratives being narratives, this can be deceptively persuasive.

The problem arises from the fact that the words from natural language are optimized for conveying our experiences – which are the result of hidden processes. Then, when we start to think about these hidden processes, we naïvely assume that we can deduce the cause of the empirical result using its natural descriptive wordings. Sadly, this breaks down as soon as things are getting a bit complex, when too much of the causing process is hidden from view. Besides, much of natural language is metaphorical; speaking figuratively is very effective — until we start taking our metaphors literally. In natural science people started by employing the same strategy. My grandfather left me a physics book in Dutch from the early nineteenth century entitled *"Over de onweegbare vloeistoffen"*, literally translatable as "About the unweighable liquids" *(note 1)*. This book deals with what could be said about electricity and heat in that period. Sometimes terms like that remain in use, losing their everyday meaning in the new context – even while the original meaning remains available in natural language. Words like electrical 'charge' are a simple example. Such a word gets a new meaning as a technical term.

Contemporary neuroscience isn't any different. Say, somewhere in the brain an activity is detected that apparently has something to do with how a certain emotional or cognitive phenomenon turns out. The published description of this finding then often may give the impression that the locus of that activity is the place where that phenomenon, for instance *fear*, is produced or even *situated*. In this way it was said that the limbic area is the *home* of our emotions; or that in a certain part of the hippocampus the *place* of *things* is encoded.

The researchers involved may well be aware that the natural term 'place' for that mental result is part of a different semantic world. In a different manner of speaking, 'place' is associated with the 'where?' question. Surely such a term will hardly cover the way in which the jumble of incoming information, combined with the pre-existing configuration of the brain apparatus, leads to the empirical result referred to as 'place'. Still, this is the way they have to talk if they don't want to get snarled up in an endless semantic maze.

As noted in *Babel or babble?* part one, neuroscience can't keep away from psychological terminology when discussing neural processes that appear to be connected with mental or behavioural phenomena. And so, preliminary findings in neuroscience may be expressed in a context using psychological terms. In their turn, psychological theories often look for support in neuroscientific findings. The problem is that psychologists then may be tempted to take the metaphors too literally. This may be combined with the slumbering tendency to lean on natural concepts and the narrative tradition.

Much talk and imagery in both fields seem part of a new phrenology. There's also a rising tide of popular publications about brain, mind and behaviour, often from pseudoscientific or obsolete theories. When such theories are published by entertainingly speculating authors, or presented as originating from someone well-versed in brain matters, they may well linger long after their sell-by date. The world of traffic science, which involves human behaviour in a technical context, is a vulnerable target.

Example 1 of part two

The first example involves an old and apparently seductive representation of the mammalian brain. In the early twentieth century, researchers discovered the similarity between inner brain parts of mammals and the dominant brain parts of more primitive animals, like fish or lizards. One thing and another led to the theoretical partitioning of the mammalian brain in an old part, considered to be reptilian, a later and more complex part on top of that, called limbic, and over all that a much more complex part called the cortex or neocortex *(note 2)*. Later on, in the sixties of that century, someone concluded that our brain was a 'triune' thing. This triune brain theory, actually more of a hypothesis, divided the brain in a simple, primitive and automatic part, a more complex and emotional part, and a still more complex and rational, albeit slower part *(fig. 2-1)*. This division was intended as a sufficient basis for explaining certain behaviours, especially behaviours when time was precious. Under threat etc. the reptilian brain took over, as it were. As a story it was simple, engaging and nicely rounded, so it gained many adherents as a theory.

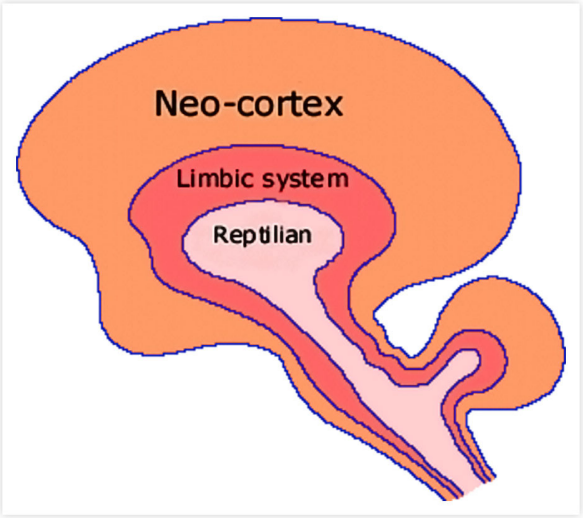

fig. 2-1 View of the Triune brain – compare this with fig. 2-4!

Even today, after half a century or more, this old chestnut still hasn't lost its appealing power. So a while ago, in Tertoolen 2014 *(reference a)*, a traffic psychologist chose it to explain, or rather apologize for, certain primitive acts and attitudes of drivers on the motorway (in American: the 'freeway'). They couldn't help it, as it were, for it was their inner reptile taking over. Road design and regulations simply had to take the triune brain into account; the inner reptile was not amenable to reason or ethics. The blog was even illustrated with an impressive and old fashioned picture of something like a tyrannosaur. Now before policy makers start basing their decisions on this impression of things, they'd better be aware of some cautionary remarks.

First, the brain parts involved may be old, but old doesn't necessarily mean primitive. The city of Nijmegen is old, as Dutch cities go – some two thousand years old, in fact. But none of the hovels from the time of *Oppidum Batavorum* is still standing. Nijmegen has *evolved* in a changing context. It boasts a renowned university.

The human brain consists of many parts, recognized by differences in structure and function. These parts, or sub organs, in their turn consist of several, more or less separate smaller parts. Many of these, or rather most of them, still can't be described in a satisfactory way as to their exact functioning. Some haven't even been studied yet. And yes, some must have a very long evolutionary history.

Indeed, brain parts with a long history share many structural and functional features with their ancient origins. However, take the amygdala, with its ancient roots: especially the part of it that is most interconnected with the cortex – with outgoing and incoming signals. In our own case this part has grown several orders of magnitude in size and complexity. It has co-evolved with the rest of the brain.

A slightly younger brain part is the hippocampus. The hippocampus was first recognized as a separate part because of its shape, which reminds one of a seahorse – hippocampus (ἱππόκαμπος) being the ancient Greek name for a mythical sea monster with a horse's body and a fishtail. Although its shape suggests a distinct apparatus with a distinct function, this sub organ seems to be involved in quite separate aspects of mental activity. At least part of the hippocampus can be seen as functionally completely integrated with the entorhinal cortex, but other parts of it have nothing to do with the spatial processes this integration implies. One, to our conception totally different function has to do with what we call memory. The role of the mammalian hippocampus and its 'parts' has evolved quite a bit since its origins in early vertebrates. Specialization is part of the story: bats may need special and maybe more complex spatial cognition, and our human cognitive memory needs are probably also quite special in their turn.

In conclusion, the triune brain story is at odds with modern neuroscience. No one active in that area takes it serious anymore.

Second, the descent of man has nothing to do with the dinosaurs. The ancestors of mammals split off from the vertebrate tree long before there were any dinosaurs around. And yes, the mammalian cortex also started to develop before the age of those giants. A special note about the maligned dinosaurs might be called for here. These creatures were not all that primitive: their brain was developing new layers too, and some cared for their young. As most of present-day dinosaurs still do, of course: the fastest dinosaur ever is alive today; it catches other dinosaurs in the air. Its name? Falco peregrinus, look it up. Yes, birds are dinosaurs.

Third, the reasoning followed in the blog example is quite untenable. If one could reason like that, the following tale – or parody – could be quite acceptable as well. In our middle ear, between the eardrum and the oval window of the actual, fluid-filled hearing organ, we have a system of three tiny bones, or ossicles *(fig. 2-2)*. These are the *malleus* (or hammer), the *incus* (or anvil) and the *stapes* (or stirrup). Their function is to transform the airborne acoustic vibrations into vibrations – or waves – adapted to a liquid environment; at the same time they seem to act like something of a dynamic equalizer. The ossicles form a system of joints, complete with tiny tendons and minuscule muscles, reputedly the smallest muscles in our body.

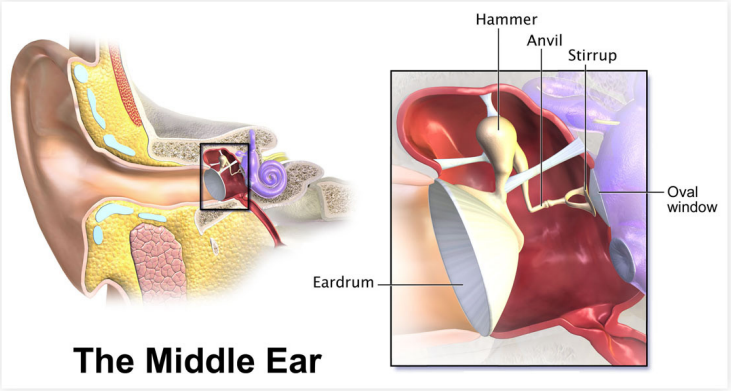

fig. 2-2 The middle ear and the three ossicles

Now the evolutionary origin of these bones must lie somewhere around the jaw system of fishes. This was further developed in reptiles; in fact, our hammer and anvil are fully homologous to parts of the reptilian jaw system *(note 3)*. But the most interesting part of this story is the ancient role of the fishes in it. For this would explain why our singing sounds so much more beautiful when we're showering and wet all over! *(fig. 2-3)*

fig. 2-3 A wonderful sound, thanks to the fishes

Of course, this is nonsense. Ancient origins don't predict later functions. But then, I don't mean to say that under circumstances we aren't apt to act unreasonably, especially when under pressure or when we're inexperienced. My point is merely that we shouldn't try to explain it with untenable hypotheses and then from such shaky premises contribute to the pessimistic notion that we can't do anything about it.

Example 2 of part two

The second example is both more and less serious. It's more serious in the sense that it's about a more scholarly intended publication, or rather several publications. It's less serious in that it's not as far beyond the mark. A few quotations are in order. (For simplicity's sake I'm following a publication history around a single author, by which I don't mean to say that there isn't anyone else expressing the same or a similar opinion – far from it.)

Vlakveld 2008 *(reference b)* stated: "Adolescents often love sensation, consider themselves invulnerable and like to impress their friends (as with a dashing driving style). Also, longitudinal research, with the help of MRI, has shown that part of the frontal cerebral cortex (the dorsolateral prefrontal cortex) isn't fully developed before the age of 25 (Giedd, 2004; Gogtay et al., 2004). This area is important for planning, seeing connections and suppressing impulses." – *(my translation)*

In Davidse et al. 2010 *(reference c)* this path is followed a bit further. In this review, citing many authors, the notion that much depends on this prefrontal cortex (PFC for short) is further developed. "State awareness, risk awareness and calibration are cognitive processes which require a well-developed prefrontal cortex. However, this part of the brain reaches full development quite late (around the age of 21). It is presumed that the rather impulsive and risky behaviour of adolescents, and therefore also the risks they take in traffic, are linked to the prefrontal cortex not yet being fully developed."

In Vlakveld 2013 *(reference d)*, we encounter the notion that young people need time before they can 'switch on' their PFC and only then 'finally' can reach the decision that a certain risk better should be avoided. And Vlakveld 2014 *(reference e)* comes to the following 'final verdict' – not as his conjecture, but as a statement of fact:

"Around the age of twelve young people reach puberty. This changes their hormone systems. That change also affects brain structures involved in emotions, motivation and enjoyment. This is known as the limbic system. In fact, at about the age of twelve this limbic system already works as in adults. The system that prevents hasty acts and that ensures us taking the (social) environment into account, however, does not come to full development until much later. Not until the age of about 25 is this

system, which is located in the prefrontal cortex (PFC), fully mature. As the maturation of the limbic system is rapid and the maturation of the PFC is slow, young people as a group are more inclined to opt for fast rewards and pleasure; the feelings of danger are less highly developed."

In fairness, it has to be noted that after a bit more of this, the author adds the caution: "However, there are individual differences; some young people hardly exhibit increased risk behaviour." But all in all, this 'verdict' claims rather much and it does so *in very definite terms* – well, overstating a tentative opinion is a common risk.

In a verbal presentation at a symposium in 2014 *(reference f)*, the same author broached the subject of incompetent behaviour by adolescents again. A witness told me afterward that the speaker blamed the PFC for that inadequacy, saying it wasn't *'rijp'* in young persons (a Dutch word with almost the same meaning as 'ripe' in English, but a bit more associated with fruit in particular). And that he used words like *'netwerk'* and *'witte stof'* (Dutch for 'network' and 'white matter'). Now I wasn't present at that occasion, so I can't say these were his literal words. But actually, that isn't the point. What matters is that some, and probably most of the audience went home with just that impression…

More cautionary remarks might be called for now. The prefrontal cortex or PFC, dorsolateral or otherwise, may be a very important contributor, but it's by no means the only brain part involved in evaluating incoming information as a basis for making behavioural or other decisions *(reference g)*. It may not even be the most important brain area involved – nobody knows yet, although probably most of the brain parts participating in such a particular functional network can't be really left out.

I know, semantic problems of the 'where's the speed' type *(reference h)* inevitably arise when I use phrases like 'evaluating incoming information as a basis for making behavioural decisions'. And my own use of 'network' might also give a too limited impression: a strictly defined system of static connections, especially to a lay audience. But the old phrase 'white matter' doesn't convey the right impression at all: it hardly covers that highly diverse, active and intricate web of *axons*, complex extensions of neurons, which are anything but just passive wiring elements. And there's a problem with 'ripe' as well: it's most commonly used for things like fruit, where ripening is a genetically preprogrammed process with a definite end stage. Whatever the research findings, that isn't necessarily true for the PFC, on the contrary.

A systematic problem is the fact that research subjects in this context are almost exclusively recruited from a culturally Western and modern environment. This means a society where being fully burdened with adult responsibilities is generally postponed until after most of the age frame mentioned for the 'maturation' of the PFC. At the same time we tend to deny young people much of natural behaviour that involves some risk, withholding any opportunity of learning how to cope with it. It might be possible that the outcome with subjects from a less 'developed' society would be quite different.

I think it's probably not all that wise to explicitly attribute the occurrence of inadequate or undesirable traffic behaviour in younger people to their prefrontal cortex not being 'ripe', especially in front of a lay audience with powerful policy makers among them. Gaining the ability to make competent and responsible behavioural decisions is a far more complex learning process, of course, involving social and cultural factors and many more parts of the brain. It is also a common experience that some persons may acquire responsible competence at quite an early age, as when at the sudden death of their parents they have to start caring for their siblings.

Finally, we should be careful with research papers outside our own specialty. Reports are often claiming too much, sometimes from enthusiasm, sometimes in the eternal competition for budget. They may be full of semantic shortcuts, which make the reader prone to misinterpret the wording. They may be part of a hype or a tunnel vision movement, and so on. Also, we ourselves may be subconsciously

tempted to cherry pick, choosing only those reports or interpretations that fit our preconceived ideas. And last but not least: research reports don't describe what *isn't* known yet.

Concluding remarks for part two

I wonder whether it's a coincidence that both examples involve a theory that seems to contribute to the notion that we can't help our irrational behaviour, at least for an important part of our lives. It might well be that this notion is somehow 'in the air' at the moment, as part of some liberal, or rather libertarian tendency. Or else it may be a sign that we are giving up the hope ever to be able to educate each other or keep ourselves in line, an idea that might well lead to a rather different approach. Let's wait and see.

Language and imagery are dangerous tools. To be sure, as noted before, it's inevitable to simplify things and we can't avoid phrasing our narratives 'in a manner of speaking'. The two parts of *Babel or babble?* are certainly not free of these crutches. But in front of a lay public, a category we should emphatically extend to policy makers, we have to avoid using expressions and images that may lead to invalid ideas.

In a written text the liberal use of quotation marks may soften such an impact, but when speaking freely we can't constantly hold a pair of crooked fingers by our ears. If we don't take care to avoid semantic confusions and muddled models, we might easily jeopardize our professional credibility. This is not just a personal risk, as it could give the powers that be a reason to ignore scientific advice. Worse, it might just as easily contribute to an oversimplified or even false understanding of traffic behaviour, and hence to harmful decisions.

Always hold on to the rule: things have to add up. Trust your senses, but be suspicious about words and theories *(reference i)*. And to use our senses well, we'll often have to step back a bit and look at what we're doing – and *saying* – from a distance.

Notes for part two

note 1 – *Imponderable fluid* is a very old idea. The term was used by Newton for the 'ether', a weightless and invisible substance surrounding atom like particles. Such an idea was also entertained by people like Galileo and Leibniz. In those days, 'imponderable' was understood as literally 'unweighable', while nowadays the abstract or figurative meaning is prevalent. Until far into the nineteenth century the studies of heat and electricity could be referred to as the *chemistry of imponderable substances*.

note 2 – Actually, *cortex* is only a general term for an outer layer. For instance, the adrenal glands – two glands on top of the kidneys that produce hormones – each have their own cortex. This cortex has sub layers too; one of these cortex layers produces the hormones called the corticosteroids, specifically glucocorticoids, like cortisol (a.k.a. hydrocortisone). What's in a name…

Our brain has two separate main parts: the cerebrum and the much smaller cerebellum, each with their own cortex. Or rather, each with their own two cortices, as cerebrum and cerebellum both consist of a left half and a right half. Confusion arises from

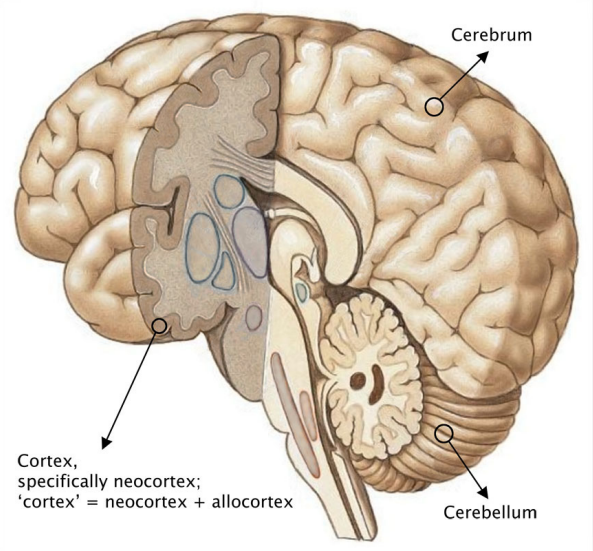

fig. 2-4 Schematic view of the human brain

the fact that with mammals, and with humans in particular, we often say cortex when we specifically mean the cortex of the cerebrum, the cerebral cortex.

And even when saying 'cortex' we generally mean the *neocortex*, the evolutionary 'youngest' outer layer of the largest part of the cerebrum. Technically, 'cerebral cortex' also contains an area that's a bit older, the *allocortex* which is the outer cell layer of the hippocampus at one end and of the olfactory bulb at the other. The most obvious difference between these two cortices is their thickness: the allocortex has only three layers of cells while the neocortex has six. Even so, 'thickness' is relative, and the thickness of the neocortex generally doesn't exceed 2 to 4 mm *(fig. 2-4)*.

The figures *(fig. 2-1 and 2-4)* show the difference between the real, more complex situation and the caricature that's often shown in texts and presentations about the triune brain. And this, while *fig. 2-4* is an extremely simplified caricature too…

note 3 – Homologous here means sharing the same origin. The reptilian jawbones referred to are called the *articular* and the *quadrate*. The stirrup evolved from the *hyomandibular bone* of fishes, and in reptiles it was already recruited for hearing under the name of *columella*.

References in part two

(reference a) Gerard Tertoolen; Evolutie op de (snel)weg, 2014; published on the author's blog http://deverkeerspsycholoog.nl/evolutie-op-de-snelweg/
and on a blog of the Knowledge Platform for Road Safety (KpVV "KpVV Weblog Reisgedrag") http://kpvv-reisgedrag.blogspot.nl/2014/05/evolutie-op-de-snelweg.html#more

(reference b) W.P. Vlakveld, Toetsen en trainen van gevaarherkenning; SWOV, Leidschendam 2008 http://www.swov.nl/rapport/D-2008-02.pdf

(reference c) R.J. Davidse, W.P. Vlakveld, M.J.A. Doumen & S. de Craen; Statusonderkenning, risico-onderkenning en kalibratie bij verkeersdeelnemers; SWOV, Leidschendam 2010 http://www.swov.nl/rapport/R-2010-02.pdf

(reference d) W.P. Vlakveld; Jonge beginnende bestuurders: zien ze gewoon de gevaren niet of accepteren ze te veel risico's?; Tijdschrift Vervoerswetenschap 49-3 2013 http://www.vervoerswetenschap.nl/attachments/article/787/4.%20Artikel%20Gevaar-herkenning%20Beginnende%20bestuurders%20voor%20TVW%28aangepast%29%20WV_akkoor

(reference e) W.P. Vlakveld; Hersenontwikkeling en ongevalsrisico van jonge bestuurders; SWOV Leidschendam 2014 http://www.swov.nl/rapport/R-2014-26.pdf

(reference f) p.c. from Mariëtte Pol, Keuzeweg, the Netherlands; 20141127 Verslag Symposium Gedrag van weggebruikers.pdf *[a PDF reporting on a symposium held on 5 November 2014, named "symposium 'Gedrag van weggebruikers: het kan verkeren'"; for some reason, all trace of it on the internet has disappeared – those interested might try the speaker involved: Willem Vlakveld at SWOV, the Netherlands]*

(reference g) T. D. Hanks, C. D. Kopec, B. W. Brunton, C. A. Duan, J. C. Erlich & C. D. Brody; Distinct relationships of parietal and prefrontal cortices to evidence accumulation; Nature 2015, doi:10.1038/nature14066

(reference h) Babel or Babble, *part one*, Words about mind and brain, a dangerous confusion of tongues *[the first part of this text]*

(reference i) Viki McCabe; Coming to Our Senses, Perceiving Complexity to Avoid Catastrophes; Oxford University Press 2014, ISBN 978-0-19-998858-7

Illustrations in part two

fig. 2-1 traditional view in many sources for the triune brain; original unknown
fig. 2-2 adapted from Blausen.com staff; Wikiversity Journal of Medicine
fig. 2-3
fig. 2-4 adapted from http://BrainMind.com/images/basalGangliaBrainstem6124.jpg

(A Dutch translation of this text is available as:
Babel of gebazel? deel twee Spraak- en beeldverwarring in de verkeerskunde)

This text has been provisionally edited for rendering by Text to Speech software
Comments are welcome

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